

# Preparing for the

# TENNESSEE

## End of Course Assessment



# Physical Science



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# Preparing for the End of Course Assessment Program Physical Science

## Introduction

### **What is this test?**

The *Tennessee End of Course Assessment Program* was established to meet the Tennessee mandate for end of course assessments in Tennessee secondary schools. The sample questions in this pamphlet are representative of the item types and item formats that will be used in the actual test.

### **What are the questions testing?**

The questions assess the content standards covered by each course as described in the performance indicators developed by the Tennessee State Department of Education and listed on their Web site.

### **Who will be tested?**

All students taking Physical Science will be tested. Tests may be given midyear for block schedules or at the end of the year.

### **How many questions are there?**

Each test contains 60 multiple-choice questions.

### **How long will the tests take?**

Students will have ample time to read and answer each of the questions. They will be given 75 minutes to complete each test.

### **How will the tests be scored?**

The answers to the multiple-choice questions will be scored by machine. The test results provide information about how well students understand the course content.

**How do I use these sample questions?**

The questions in the pamphlet are, for the most part, representative samples of the types of questions that will be on the Physical Science test. The questions are presented in a format similar to that which will be used in the actual test.

Reporting Categories and Performance Indicators have been provided for the questions in this pamphlet only. These Reporting Categories group the Physical Science Performance Indicators together. When students receive their reports from the test, these Reporting Categories will be used to report scores on student performance. The questions in the actual test will not have this identifying information.

These questions can be used for a classroom learning session or as an individual, short practice test to prepare students for the actual test. Various item formats have been selected in order to familiarize students with the actual test format.

The items in this Preparation Brochure will **not** be found on the End of Course tests. The number of items in this Preparation Brochure does not reflect the emphasis of content on the test.

An answer key for the sample questions is provided at the end of this pamphlet.

**What tips are there for taking the test?**

**RELAX:** It is normal to be somewhat nervous before the test. Remember that the score is only one of a number of measures of your performance.

**LISTEN:** Listen to and read the test directions carefully. Ask for an explanation of the directions if you do not understand them. Follow the directions.

**PLAN YOUR TIME:** Do not spend too much time on any one question. If a question seems to take too long, skip it and return to it later if you have extra time. First answer all the questions you are sure about.

**THINK:** If you are not sure how to answer a question, read it again and try your best to answer the question. Rule out answer choices that you know are incorrect and choose from those that remain.

## Physical Science Formula Page

### Velocity

$$v = \frac{d}{t}$$

Where

$v$  = velocity in meters per second (m/s)

$d$  = distance in meters (m)

$t$  = time in seconds (s)

### Acceleration

$$a = \frac{\Delta v}{t}$$

Where

$a$  = acceleration in meters per second per second (m/s<sup>2</sup>)

$\Delta v$  = change in velocity in meters per second (m/s)

$t$  = time in seconds (s)

### Force

$$F = ma$$

Where

$F$  = force in newtons (N)

$m$  = mass in kilograms (kg)

$a$  = acceleration in meters per second per second (m/s<sup>2</sup>)

### Work

$$W = Fd$$

Where

$W$  = work in joules (J)

$F$  = force in newtons (N)

$d$  = distance in meters (m)

### Power

$$P = \frac{W}{t}$$

Where

$P$  = power in watts (W)

$W$  = work in joules (J)

$t$  = time in seconds (s)

### Density

$$D = \frac{m}{V}$$

Where

$D$  = density in grams per centimeter cubed (g/cm<sup>3</sup>)  
or grams per milliliter (g/mL)

$m$  = mass in grams (g)

$V$  = volume in centimeters cubed (cm<sup>3</sup>) or milliliters (mL)

### Ideal Gas Laws

#### Boyle's Law

$$P_1 V_1 = P_2 V_2$$

Where

$P_1$  = initial pressure

$V_1$  = initial volume

$P_2$  = final pressure

$V_2$  = final volume

#### Combined Gas Law

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

Where

$P_1$  = initial pressure

$V_1$  = initial volume

$T_1$  = initial temperature in kelvin

$P_2$  = final pressure

$V_2$  = final volume

$T_2$  = final temperature in kelvin

#### Charles' Law

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Where

$V_1$  = initial volume

$T_1$  = initial temperature in kelvin

$V_2$  = final volume

$T_2$  = final temperature in kelvin

#### Heat Lost or Gained $Q = mc\Delta T$

Where

$m$  = mass in kilograms (kg)

$c$  = specific heat capacity in  
joules per kilogram kelvin (J/kgK)

$\Delta T$  = change in temperature in kelvin

### Ideal Mechanical Advantage

$$IMA = \frac{D_e}{D_r}$$

Where

$IMA$  = ideal mechanical advantage

$D_e$  = effort distance in meters (m)

$D_r$  = resistance distance in meters (m)

### Actual Mechanical Advantage

$$AMA = \frac{F_r}{F_e}$$

Where

$AMA$  = actual mechanical advantage

$F_r$  = resistance force in Newtons (N)

$F_e$  = effort force in Newtons (N)

### % Efficiency

$$\% \text{ Efficiency} = \frac{W_{\text{out}}}{W_{\text{in}}}$$

Where

$W_{\text{out}}$  = work output

$W_{\text{in}}$  = work input

### Electricity

#### Ohm's Law $V = IR$

Where

$V$  = electrical potential in volts (V)

$I$  = current in amperes (A)

$R$  = resistance in ohms ( $\Omega$ )

# Periodic Table of the Elements

|                                 |  |                                    |  |  |  |  |  |  |  |  |  |                                  |  |  |  |  |  |  |  |  |  |                                  |  |  |  |  |  |  |  |  |  |                                    |  |  |  |  |  |  |  |  |  |                                  |  |  |  |  |  |  |  |  |  |                                    |  |  |  |  |  |  |  |  |  |                                    |  |  |  |  |  |  |  |  |  |                         |  |  |  |  |  |  |  |  |  |                        |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                        |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                     |  |  |  |  |  |  |  |  |  |
|---------------------------------|--|------------------------------------|--|--|--|--|--|--|--|--|--|----------------------------------|--|--|--|--|--|--|--|--|--|----------------------------------|--|--|--|--|--|--|--|--|--|------------------------------------|--|--|--|--|--|--|--|--|--|----------------------------------|--|--|--|--|--|--|--|--|--|------------------------------------|--|--|--|--|--|--|--|--|--|------------------------------------|--|--|--|--|--|--|--|--|--|-------------------------|--|--|--|--|--|--|--|--|--|------------------------|--|--|--|--|--|--|--|--|--|-----------------------|--|--|--|--|--|--|--|--|--|------------------------|--|--|--|--|--|--|--|--|--|----------------------|--|--|--|--|--|--|--|--|--|-----------------------|--|--|--|--|--|--|--|--|--|----------------------|--|--|--|--|--|--|--|--|--|-----------------------|--|--|--|--|--|--|--|--|--|----------------------|--|--|--|--|--|--|--|--|--|---------------------|--|--|--|--|--|--|--|--|--|
| 1<br>1<br>hydrogen<br>H<br>1.01 |  | 2<br>4<br>beryllium<br>Be<br>9.012 |  |  |  |  |  |  |  |  |  | 18<br>2<br>helium<br>He<br>4.003 |  |  |  |  |  |  |  |  |  |                                  |  |  |  |  |  |  |  |  |  |                                    |  |  |  |  |  |  |  |  |  |                                  |  |  |  |  |  |  |  |  |  |                                    |  |  |  |  |  |  |  |  |  |                                    |  |  |  |  |  |  |  |  |  |                         |  |  |  |  |  |  |  |  |  |                        |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                        |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                     |  |  |  |  |  |  |  |  |  |
|                                 |  |                                    |  |  |  |  |  |  |  |  |  |                                  |  |  |  |  |  |  |  |  |  |                                  |  |  |  |  |  |  |  |  |  |                                    |  |  |  |  |  |  |  |  |  |                                  |  |  |  |  |  |  |  |  |  |                                    |  |  |  |  |  |  |  |  |  |                                    |  |  |  |  |  |  |  |  |  |                         |  |  |  |  |  |  |  |  |  |                        |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                        |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                     |  |  |  |  |  |  |  |  |  |
| 3<br>lithium<br>Li<br>6.941     |  | 11<br>sodium<br>Na<br>22.99        |  |  |  |  |  |  |  |  |  | 13<br>5<br>boron<br>B<br>10.811  |  |  |  |  |  |  |  |  |  | 14<br>6<br>carbon<br>C<br>12.011 |  |  |  |  |  |  |  |  |  | 15<br>7<br>nitrogen<br>N<br>14.007 |  |  |  |  |  |  |  |  |  | 16<br>8<br>oxygen<br>O<br>15.999 |  |  |  |  |  |  |  |  |  | 17<br>9<br>fluorine<br>F<br>18.998 |  |  |  |  |  |  |  |  |  | 20.18<br>10<br>neon<br>Ne<br>20.18 |  |  |  |  |  |  |  |  |  |                         |  |  |  |  |  |  |  |  |  |                        |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                        |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                     |  |  |  |  |  |  |  |  |  |
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| 12<br>magnesium<br>Mg           |  | 12<br>aluminum<br>Al               |  |  |  |  |  |  |  |  |  | 13<br>aluminum<br>Al             |  |  |  |  |  |  |  |  |  | 14<br>silicon<br>Si              |  |  |  |  |  |  |  |  |  | 15<br>phosphorus<br>P              |  |  |  |  |  |  |  |  |  | 16<br>sulfur<br>S                |  |  |  |  |  |  |  |  |  | 17<br>chlorine<br>Cl               |  |  |  |  |  |  |  |  |  | 18<br>argon<br>Ar                  |  |  |  |  |  |  |  |  |  |                         |  |  |  |  |  |  |  |  |  |                        |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                        |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                     |  |  |  |  |  |  |  |  |  |
|                                 |  |                                    |  |  |  |  |  |  |  |  |  |                                  |  |  |  |  |  |  |  |  |  |                                  |  |  |  |  |  |  |  |  |  |                                    |  |  |  |  |  |  |  |  |  |                                  |  |  |  |  |  |  |  |  |  |                                    |  |  |  |  |  |  |  |  |  |                                    |  |  |  |  |  |  |  |  |  |                         |  |  |  |  |  |  |  |  |  |                        |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                        |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                     |  |  |  |  |  |  |  |  |  |
| 19<br>potassium<br>K            |  | 20<br>calcium<br>Ca                |  |  |  |  |  |  |  |  |  | 21<br>scandium<br>Sc             |  |  |  |  |  |  |  |  |  | 22<br>titanium<br>Ti             |  |  |  |  |  |  |  |  |  | 23<br>vanadium<br>V                |  |  |  |  |  |  |  |  |  | 24<br>chromium<br>Cr             |  |  |  |  |  |  |  |  |  | 25<br>manganese<br>Mn              |  |  |  |  |  |  |  |  |  | 26<br>iron<br>Fe                   |  |  |  |  |  |  |  |  |  | 27<br>cobalt<br>Co      |  |  |  |  |  |  |  |  |  | 28<br>nickel<br>Ni     |  |  |  |  |  |  |  |  |  | 29<br>copper<br>Cu    |  |  |  |  |  |  |  |  |  | 30<br>zinc<br>Zn       |  |  |  |  |  |  |  |  |  | 31<br>gallium<br>Ga  |  |  |  |  |  |  |  |  |  | 32<br>germanium<br>Ge |  |  |  |  |  |  |  |  |  | 33<br>arsenic<br>As  |  |  |  |  |  |  |  |  |  | 34<br>selenium<br>Se  |  |  |  |  |  |  |  |  |  | 35<br>bromine<br>Br  |  |  |  |  |  |  |  |  |  | 36<br>krypton<br>Kr |  |  |  |  |  |  |  |  |  |
|                                 |  |                                    |  |  |  |  |  |  |  |  |  |                                  |  |  |  |  |  |  |  |  |  |                                  |  |  |  |  |  |  |  |  |  |                                    |  |  |  |  |  |  |  |  |  |                                  |  |  |  |  |  |  |  |  |  |                                    |  |  |  |  |  |  |  |  |  |                                    |  |  |  |  |  |  |  |  |  |                         |  |  |  |  |  |  |  |  |  |                        |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                        |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                     |  |  |  |  |  |  |  |  |  |
| 37<br>rubidium<br>Rb            |  | 38<br>strontium<br>Sr              |  |  |  |  |  |  |  |  |  | 39<br>yttrium<br>Y               |  |  |  |  |  |  |  |  |  | 40<br>zirconium<br>Zr            |  |  |  |  |  |  |  |  |  | 41<br>niobium<br>Nb                |  |  |  |  |  |  |  |  |  | 42<br>molybdenum<br>Mo           |  |  |  |  |  |  |  |  |  | 43<br>technetium<br>Tc             |  |  |  |  |  |  |  |  |  | 44<br>ruthenium<br>Ru              |  |  |  |  |  |  |  |  |  | 45<br>rhodium<br>Rh     |  |  |  |  |  |  |  |  |  | 46<br>palladium<br>Pd  |  |  |  |  |  |  |  |  |  | 47<br>silver<br>Ag    |  |  |  |  |  |  |  |  |  | 48<br>cadmium<br>Cd    |  |  |  |  |  |  |  |  |  | 49<br>indium<br>In   |  |  |  |  |  |  |  |  |  | 50<br>tin<br>Sn       |  |  |  |  |  |  |  |  |  | 51<br>antimony<br>Sb |  |  |  |  |  |  |  |  |  | 52<br>tellurium<br>Te |  |  |  |  |  |  |  |  |  | 53<br>iodine<br>I    |  |  |  |  |  |  |  |  |  | 54<br>xenon<br>Xe   |  |  |  |  |  |  |  |  |  |
|                                 |  |                                    |  |  |  |  |  |  |  |  |  |                                  |  |  |  |  |  |  |  |  |  |                                  |  |  |  |  |  |  |  |  |  |                                    |  |  |  |  |  |  |  |  |  |                                  |  |  |  |  |  |  |  |  |  |                                    |  |  |  |  |  |  |  |  |  |                                    |  |  |  |  |  |  |  |  |  |                         |  |  |  |  |  |  |  |  |  |                        |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                        |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                     |  |  |  |  |  |  |  |  |  |
| 55<br>cesium<br>Cs              |  | 56<br>barium<br>Ba                 |  |  |  |  |  |  |  |  |  | 57<br>lanthanum<br>La            |  |  |  |  |  |  |  |  |  | 72<br>hafnium<br>Hf              |  |  |  |  |  |  |  |  |  | 73<br>tantalum<br>Ta               |  |  |  |  |  |  |  |  |  | 74<br>tungsten<br>W              |  |  |  |  |  |  |  |  |  | 75<br>rhenium<br>Re                |  |  |  |  |  |  |  |  |  | 76<br>osmium<br>Os                 |  |  |  |  |  |  |  |  |  | 77<br>iridium<br>Ir     |  |  |  |  |  |  |  |  |  | 78<br>platinum<br>Pt   |  |  |  |  |  |  |  |  |  | 79<br>gold<br>Au      |  |  |  |  |  |  |  |  |  | 80<br>mercury<br>Hg    |  |  |  |  |  |  |  |  |  | 81<br>thallium<br>Tl |  |  |  |  |  |  |  |  |  | 82<br>lead<br>Pb      |  |  |  |  |  |  |  |  |  | 83<br>bismuth<br>Bi  |  |  |  |  |  |  |  |  |  | 84<br>polonium<br>Po  |  |  |  |  |  |  |  |  |  | 85<br>astatine<br>At |  |  |  |  |  |  |  |  |  | 86<br>radon<br>Rn   |  |  |  |  |  |  |  |  |  |
|                                 |  |                                    |  |  |  |  |  |  |  |  |  |                                  |  |  |  |  |  |  |  |  |  |                                  |  |  |  |  |  |  |  |  |  |                                    |  |  |  |  |  |  |  |  |  |                                  |  |  |  |  |  |  |  |  |  |                                    |  |  |  |  |  |  |  |  |  |                                    |  |  |  |  |  |  |  |  |  |                         |  |  |  |  |  |  |  |  |  |                        |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                        |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                     |  |  |  |  |  |  |  |  |  |
| 87<br>francium<br>Fr            |  | 88<br>radium<br>Ra                 |  |  |  |  |  |  |  |  |  | 89<br>actinium<br>Ac             |  |  |  |  |  |  |  |  |  | 104<br>rutherfordium<br>Rf       |  |  |  |  |  |  |  |  |  | 105<br>dubnium<br>Db               |  |  |  |  |  |  |  |  |  | 106<br>seaborgium<br>Sg          |  |  |  |  |  |  |  |  |  | 107<br>bohrium<br>Bh               |  |  |  |  |  |  |  |  |  | 108<br>hassium<br>Hs               |  |  |  |  |  |  |  |  |  | 109<br>meitnerium<br>Mt |  |  |  |  |  |  |  |  |  | 110<br>ununnium<br>Uun |  |  |  |  |  |  |  |  |  | 111<br>ununium<br>Uuu |  |  |  |  |  |  |  |  |  | 112<br>unbinium<br>Uub |  |  |  |  |  |  |  |  |  | 204.38               |  |  |  |  |  |  |  |  |  | 208.98                |  |  |  |  |  |  |  |  |  | 210                  |  |  |  |  |  |  |  |  |  | 222                   |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                     |  |  |  |  |  |  |  |  |  |
|                                 |  |                                    |  |  |  |  |  |  |  |  |  |                                  |  |  |  |  |  |  |  |  |  |                                  |  |  |  |  |  |  |  |  |  |                                    |  |  |  |  |  |  |  |  |  |                                  |  |  |  |  |  |  |  |  |  |                                    |  |  |  |  |  |  |  |  |  |                                    |  |  |  |  |  |  |  |  |  |                         |  |  |  |  |  |  |  |  |  |                        |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                        |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                       |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |                     |  |  |  |  |  |  |  |  |  |

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|---------------------|--|--------------------------|--|-----------------------|--|------------------------|--|-----------------------|--|-----------------------|--|------------------------|--|-----------------------|--|-------------------------|--|-------------------------|--|----------------------|--|--------------------------|--|-----------------------|--|-------------------------|--|
| 58<br>cerium<br>Ce  |  | 59<br>praseodymium<br>Pr |  | 60<br>neodymium<br>Nd |  | 61<br>promethium<br>Pm |  | 62<br>samarium<br>Sm  |  | 63<br>europium<br>Eu  |  | 64<br>gadolinium<br>Gd |  | 65<br>terbium<br>Tb   |  | 66<br>dysprosium<br>Dy  |  | 67<br>holmium<br>Ho     |  | 68<br>erbium<br>Er   |  | 69<br>thulium<br>Tm      |  | 70<br>ytterbium<br>Yb |  | 71<br>lutetium<br>Lu    |  |
|                     |  |                          |  |                       |  |                        |  |                       |  |                       |  |                        |  |                       |  |                         |  |                         |  |                      |  |                          |  |                       |  |                         |  |
| 90<br>thorium<br>Th |  | 91<br>protactinium<br>Pa |  | 92<br>uranium<br>U    |  | 93<br>neptunium<br>Np  |  | 94<br>plutonium<br>Pu |  | 95<br>americium<br>Am |  | 96<br>curium<br>Cm     |  | 97<br>berkelium<br>Bk |  | 98<br>californium<br>Cf |  | 99<br>einsteinium<br>Es |  | 100<br>fermium<br>Fm |  | 101<br>mendelevium<br>Md |  | 102<br>nobelium<br>No |  | 103<br>lawrencium<br>Lr |  |
|                     |  |                          |  |                       |  |                        |  |                       |  |                       |  |                        |  |                       |  |                         |  |                         |  |                      |  |                          |  |                       |  |                         |  |

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**Reporting Category:** Force and Motion  
**Numbers 1 through 11**

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**Performance Indicator:** Distinguish between speed and velocity, given a scenario.

**1** Four statements involving motion are listed below.

A horse exercises while walking at  $1.0 \frac{\text{m}}{\text{s}}$  in a circular path.  
A person walks a straight path at  $1.0 \frac{\text{m}}{\text{s}}$ .  
A girl walks due north at  $1.0 \frac{\text{m}}{\text{s}}$  to her classroom.  
A model car averages  $1.0 \frac{\text{m}}{\text{s}}$  while moving along a curved track.

A student labels each statement in the table as either a speed statement or a velocity statement. The table will most likely have

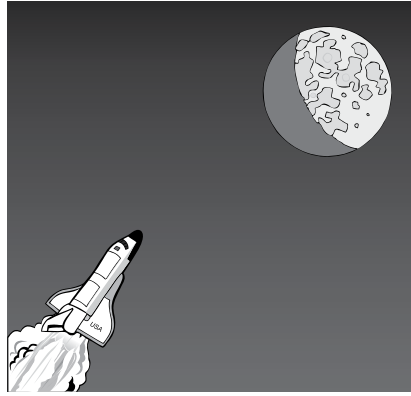
- A** one speed and three velocity statements
- B** two speed and two velocity statements
- C** three speed and one velocity statements
- D** four speed and no velocity statements

EP010134



**Performance Indicator:** Relate inertia, force, or action-reaction forces to Newton's three laws of motion, given an illustration, diagram, or scenario.

- 2** A space shuttle moving through space is shown below.



Which law below best explains why a space shuttle is able to suddenly change direction in outer space?

- F** Newton's first law of motion (inertia law)
- G** Newton's third law of motion (action–reaction principle)
- H** the law of universal gravitation (objects with mass attract each other)
- J** Newton's second law of motion (net force causes acceleration)

EP010135

**Performance Indicator:** Distinguish between mass and weight using SI units, given examples.

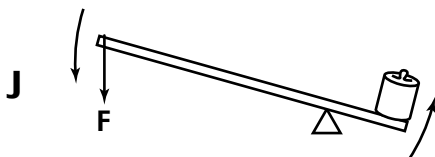
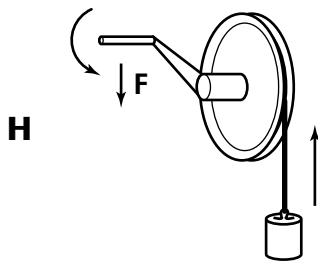
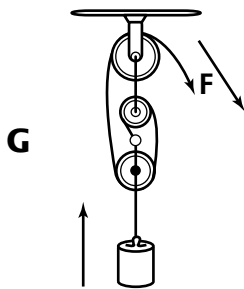
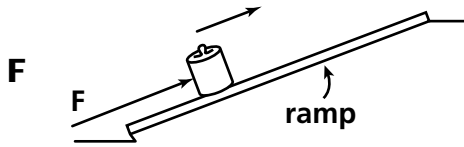
- 3** Which correctly identifies the mass and approximate weight of the same object on Earth?

- A** 20-kg mass, 20,000-g weight
- B** 20-kg mass, 200-N weight
- C** 20-N mass, 2-kg weight
- D** 20-N mass, 200-g weight

EP020404

**Performance Indicator:** Identify simple machines, given illustrations of machines in action.

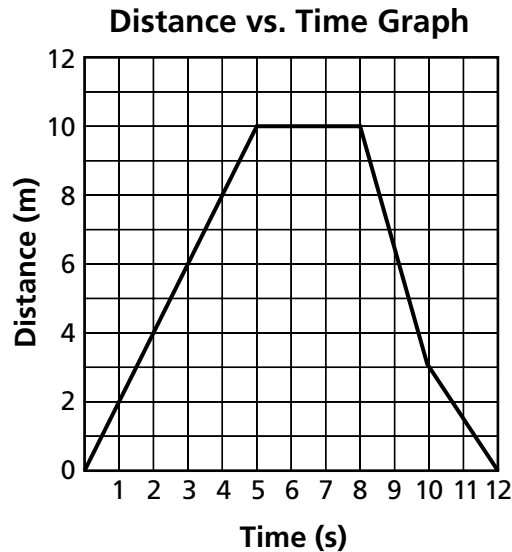
**4** Which of the machines shown is an inclined plane?



EP030001

**Performance Indicator:** Interpret a distance-time graph for velocity or a velocity-time graph for acceleration, given the appropriate graph.

- 5** The following graph shows the distance an object travels during a 12-second period.



At which time interval is the velocity zero?

- A** 0–5 s
- B** 5–8 s
- C** 8–10 s
- D** 10–12 s

EP010385

**Performance Indicator:** Solve application problems related to velocity, acceleration, force, work, and power using appropriate units of measurement, given the equations.

- 6** What is the acceleration of a cyclist who starts from rest and achieves a final velocity of  $6 \frac{\text{m}}{\text{s}}$  after 10 seconds?

- F**  $0.60 \frac{\text{m}}{\text{s}}$
- G**  $0.60 \frac{\text{m}}{\text{s}^2}$
- H**  $60 \frac{\text{m}}{\text{s}}$
- J**  $60 \frac{\text{m}}{\text{s}^2}$

EP010262

**Performance Indicator:** Distinguish among the concepts inherent in Newton's three laws of motion, given a scenario.

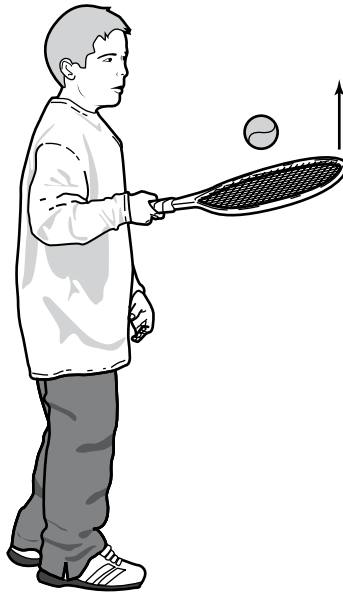
**7** During a launch, a rocket moves upward. Which best describes the action-reaction force pair for the rocket during the launch?

- A** Hot gases push against the rocket, while the rocket pushes against the hot gases.
- B** The ground pushes up on the rocket, while hot exhaust gases push down on the ground.
- C** The rocket pushes down on the atmosphere, while gravity pushes up on the rocket.
- D** Gravity pushes down on the rocket, while the atmosphere pushes up on the rocket.

EP010389

**Performance Indicator:** Choose the illustration or scenario that relates the effect of gravitational force on falling bodies or satellites.

**8** A boy is bouncing a ball straight up into the air with a tennis racket.



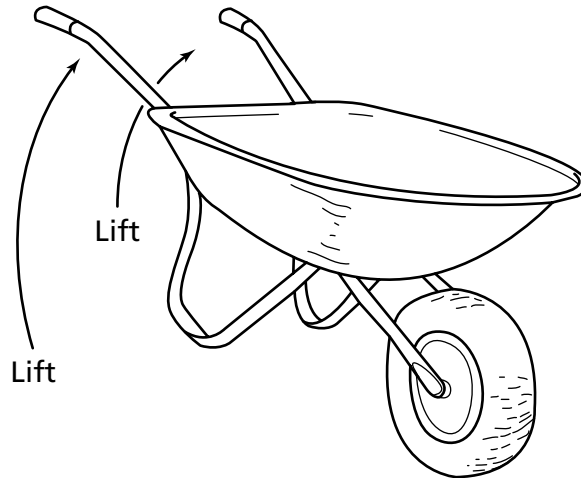
**As the ball is rising, how is the ball affected by gravity?**

- F** Gravity causes the ball to increase its upward speed.
- G** Gravity causes the speed of the ball to stay the same.
- H** Gravity causes the ball to accelerate downward.
- J** Gravity causes the ball to accelerate upward.

EP020221

**Performance Indicator:** Recognize the simple machines found in a compound machine, given an illustration of a machine in action.

- 9** The following compound machine can be used to lift rocks and soil.



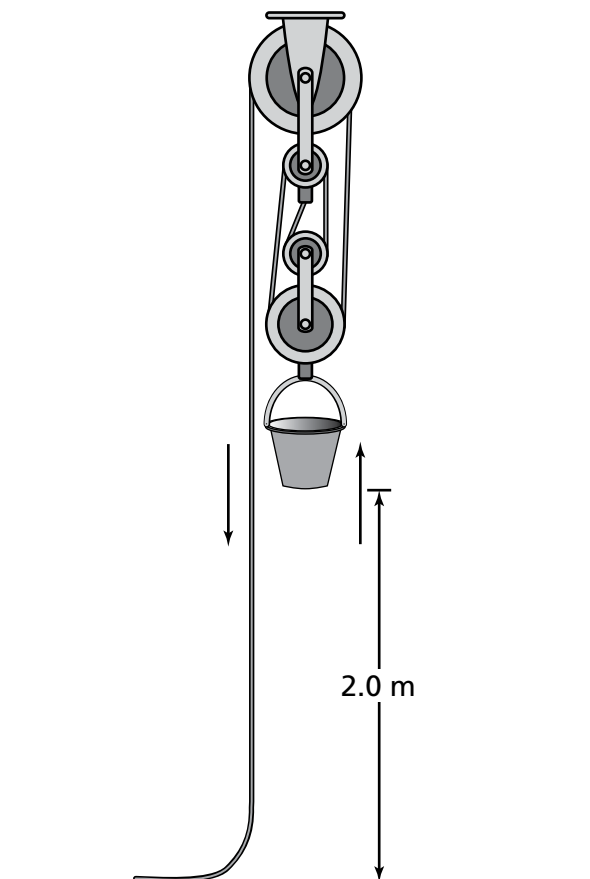
Which simple machine is most similar to the wheelbarrow when it is used to lift rocks and soil?

- A** wedge
- B** lever
- C** pulley
- D** inclined plane

EP010392

**Performance Indicator:** Solve application problems related to mechanical advantage and the efficiency of simple machines, given appropriate equations.

- 10** The pulley system shown below is designed to reduce the effort when lifting. The 115-N pail is lifted a height of 2.0 m with an effort of 35 N. When the effort is applied, the effort rope moves 8.0 m.



What is the percent efficiency of this simple machine?

- F** 25%
- G** 30%
- H** 82%
- J** 328%

EP020427

**Performance Indicator:** Choose the correct representation of the law of conservation of momentum, given an illustration.

- 11** A 1000-kg block moving westward at  $8 \frac{\text{m}}{\text{s}}$  slides into a 10,000-kg block moving the same direction at  $7 \frac{\text{m}}{\text{s}}$ . The two blocks lock together. Immediately following the collision, the speed of the connected blocks is

**A**  $6.5 \frac{\text{m}}{\text{s}}$

**B**  $7.1 \frac{\text{m}}{\text{s}}$

**C**  $5.6 \frac{\text{m}}{\text{s}}$

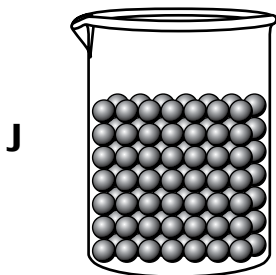
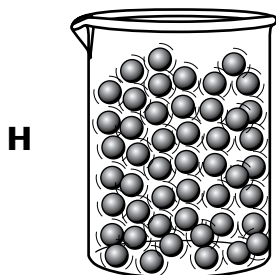
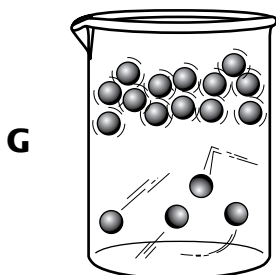
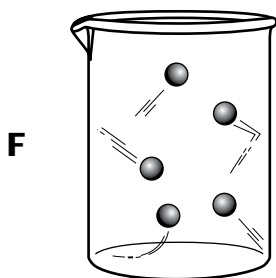
**D**  $8.0 \frac{\text{m}}{\text{s}}$

EP020039

**Reporting Category:**  
Numbers 12 through 22**Structure and Properties of Matter**

**Performance Indicator:** Distinguish among the phases of matter in terms of volume, shape, and particle arrangement, given illustrations.

**12** Which best displays how particles are arranged in a solid?



EP020216



**Performance Indicator:** Identify a material as a pure substance or a mixture, given a description of the material.

**13** Which of the following is most likely a pure substance?

- A** a smooth cake batter
- B** a glass of water that tastes salty
- C** a dark gray solid that attracts iron filings
- D** a sample of air captured from the atmosphere

EP020208

**Performance Indicator:** Distinguish among elements, compounds, solutions, colloids, and suspensions, given examples.

**14** A beaker of liquid containing small, visible particles is observed. From this observation, the contents of the beaker could best be classified as

- F** a compound
- G** a solution
- H** an element
- J** a suspension

EP010147

**Performance Indicator:** Identify common elements, given symbols or names.

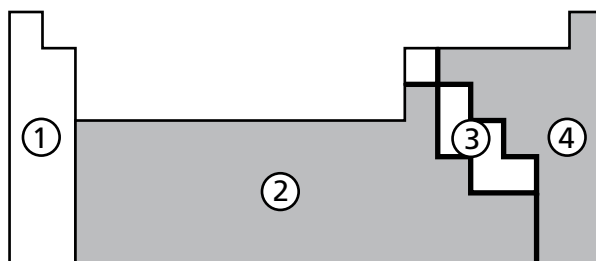
**15** The symbol for the element copper is

- A** C
- B** Co
- C** CO
- D** Cu

EP030004

**Performance Indicator:** Distinguish between metals and nonmetals, given examples.

- 16** Below is the outline of the periodic table of the elements with four areas identified by numbers.



In which numbered area would an element classified as a nonmetal most likely be found?

- F** 1
- G** 2
- H** 3
- J** 4

EP010148

**Performance Indicator:** Identify the three major subatomic particles (protons, neutrons, and electrons) based on their location, charge, and relative mass, given descriptions.

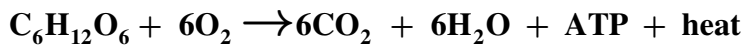
- 17** Which subatomic particle has no net charge and is found within the nucleus?

- A** electron
- B** neutron
- C** proton
- D** cation

EP010421

**Performance Indicator:** Identify chemical formulas for common compounds (i.e.,  $\text{H}_2\text{O}$ ,  $\text{NaCl}$ ,  $\text{CO}_2$ ,  $\text{HCl}$ ,  $\text{Fe}_2\text{O}_3$ ,  $\text{C}_6\text{H}_{12}\text{O}_6$ ,  $\text{NaOH}$ ).

- 18** The equation below shows a simplified reaction that occurs in cells.



Which best describes the underlined parts of the reaction?

- F** Carbon dioxide plus oxygen produces water and glucose.
- G** Oxygen plus water produces carbon dioxide and glucose.
- H** Glucose plus oxygen produces carbon dioxide and water.
- J** Water plus carbon dioxide produces glucose and oxygen.

EP020116

**Performance Indicator:** Solve application problems related to density, mass, and volume, given the equation.

- 19** A block of aluminum has a density of  $2.7 \frac{\text{g}}{\text{cm}^3}$  and a volume of  $4.0 \text{ cm}^3$ . What is the mass of the aluminum?

- A** 0.68 g
- B** 1.3 g
- C** 1.5 g
- D** 10.8 g

EP010427

**Performance Indicator:** Predict the behavior of an object in a fluid, given relative densities.

- 20** Which solid object with the density shown below will float when placed in a container of distilled water, which has a density of  $1.0 \frac{\text{g}}{\text{mL}}$ ?

- F**  $17 \frac{\text{g}}{\text{mL}}$
- G**  $0.64 \frac{\text{g}}{\text{mL}}$
- H**  $4.7 \frac{\text{g}}{\text{mL}}$
- J**  $1.2 \frac{\text{g}}{\text{mL}}$

EP010122

**Performance Indicator:** Identify the atomic number, atomic mass, number of protons, number of neutrons, and number of electrons in an atom of a given element, using the periodic table.

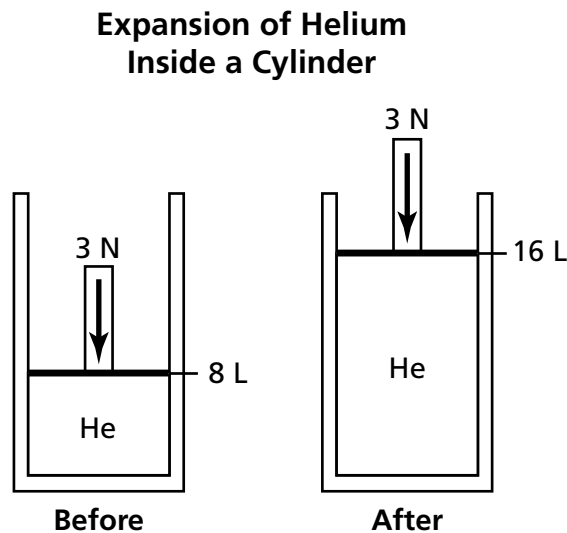
**21** How many neutrons are most likely found in an atom of radon (Rn)?

- A** 86
- B** 136
- C** 222
- D** 308

EP010072

**Performance Indicator:** Analyze the relationships among pressure, temperature, volume and speed of gases, given a scenario.

**22** The following diagram shows a closed steel cylinder containing Helium (He). The force on top of the piston stays the same. The volume inside the cylinder doubles.



What most likely causes the volume to increase in the cylinder?

- F** Helium atoms increase in size.
- G** The temperature increases.
- H** The pressure decreases.
- J** Helium atoms decrease in average speed.

EP010365

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**Reporting Category:** Interactions of Matter  
**Numbers 23 through 33**

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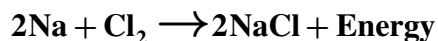
**Performance Indicator:** Determine whether a change in matter is physical or chemical, given a scenario.

**23** Which process involves a chemical change?

- A** Exposed iron in a moist environment rusts.
- B** Candle wax changes from a solid to a liquid.
- C** Water evaporates from a heated test tube.
- D** Sugar dissolves in hot water.

EP010155

**Performance Indicator:** Identify the reactants and/or products in a chemical reaction, given a chemical equation.

**24** A chemical synthesis reaction is shown below.

**What compound is produced in this reaction?**

- F** calcium chloride
- G** sodium chloride
- H** potassium chloride
- J** magnesium chloride

EP010226

**Performance Indicator:** Identify a substance as acidic, basic, or neutral, given its pH.

**25** Which solution is most acidic?

- A** cranapple juice, pH = 5.0
- B** salad dressing, pH = 4.5
- C** pickle juice, pH = 3.0
- D** lye water, pH = 10.0

EP030009

**26** The pH of several solutions is listed.

**pH Table**

| Solution | pH   |
|----------|------|
| 1        | 0.5  |
| 2        | 1.0  |
| 3        | 10.0 |
| 4        | 10.5 |

Which solution is the most basic?

- F** 1
- G** 2
- H** 3
- J** 4

EP030010

**Performance Indicator:** Identify a chemical bond as ionic or covalent, given the elements in a compound.

**27** What type of chemical bond is formed between the atoms in calcium chloride ( $\text{CaCl}_2$ )?

- A** covalent
- B** hydrogen
- C** ionic
- D** metallic

EP020361

**Performance Indicator:** Identify a chemical reaction as synthesis, decomposition, single-replacement, or double-replacement, given an equation.

**28** During an electrolysis experiment, water is transformed into hydrogen gas and oxygen gas, as shown below.



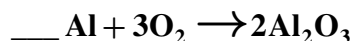
This type of reaction is a

- F** synthesis reaction
- G** decomposition reaction
- H** single-replacement reaction
- J** double-replacement reaction

EP010228

**Performance Indicator:** Select the correct coefficient(s) to balance a chemical equation, given a list of coefficients.

**29** The chemical equation for the production of aluminum oxide is shown below.



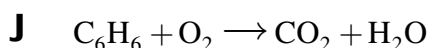
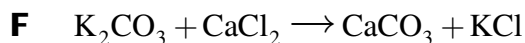
Which coefficient would correctly balance the equation?

- A** 2
- B** 4
- C** 6
- D** 8

EP010203

**Performance Indicator:** Apply the law of conservation of mass in a chemical reaction by selecting the balanced equation.

**30 Which chemical equation is balanced?**



EP010076

**Performance Indicator:** Distinguish between endothermic and exothermic reactions, given a description of the temperature change in a reaction.

**31 A student hypothesizes that the reaction between an antacid tablet and water will be endothermic. If the hypothesis is correct, which of the following should occur when the tablet is placed in water?**

**A** The temperature of the mixture should drop.

**B** The temperature of the container should increase.

**C** The water should cool as the tablet warms.

**D** The tablet should cool as the water warms.

EP020199

**Performance Indicator:** Identify the effect of acid rain on the environment, given a scenario.

**32 Which of the following is the most likely effect of acid rain on plants?**

**F** damage to the leaves

**G** increase in growth rate

**H** loss of needed oxygen

**J** too many roots formed

EP020352



**Performance Indicator:** Select the product(s) given the reactant(s) of a chemical reaction.

**33** The equation below shows a chemical reaction.



Which products complete the equation for this double-replacement reaction?

- A** Pb, NO<sub>3</sub>, Na, I
- B** PbNaI(NO<sub>3</sub>)<sub>2</sub>
- C** PbI<sub>2</sub>, NaNO<sub>3</sub>
- D** PbNa, INO<sub>3</sub>

EP020358

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**Reporting Category:** Energy  
**Numbers 34 through 43**

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**Performance Indicator:** Classify a wave as transverse or longitudinal, given a description or an illustration.

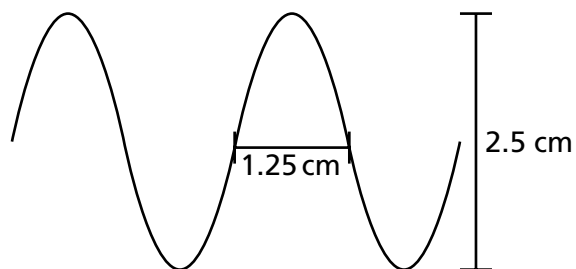
**34** A fire truck sounds a siren as it travels along a road. The siren produces which type of wave?

- F** longitudinal
- G** radio
- H** infrared
- J** cosmic

EP010317

**Performance Indicator:** Identify wavelength, frequency and amplitude, given a description or an illustration.

- 35** An illustration of a transverse wave is shown below.



What are the magnitudes of the wavelength ( $\lambda$ ) and amplitude (A) of the wave?

- A**  $\lambda = 1.25$  cm,  $A = 1.25$  cm
- B**  $\lambda = 2.5$  cm,  $A = 1.25$  cm
- C**  $\lambda = 1.25$  cm,  $A = 2.5$  cm
- D**  $\lambda = 2.5$  cm,  $A = 5.0$  cm

EP010016

**Performance Indicator:** Identify the boiling and/or freezing point of water, given the Celsius, Fahrenheit, or Kelvin temperature scales.

- 36** Which temperature scale is being used if the thermometer reads 100 degrees when placed in boiling water?

- F** Kelvin
- G** Celsius
- H** Rankine
- J** Fahrenheit

EP010131

**Performance Indicator:** Classify sound as a longitudinal, mechanical wave and light as a transverse, electromagnetic wave, given an illustration or description.

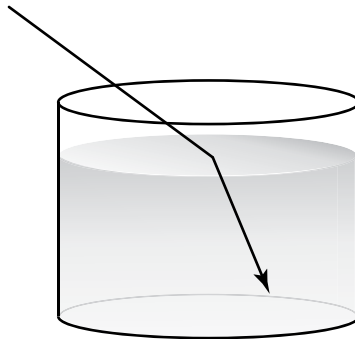
**37** The waves produced by a blaring fog horn are best classified as

- A** transverse electromagnetic waves
- B** longitudinal mechanical waves
- C** transverse mechanical waves
- D** longitudinal electromagnetic waves

EP020360

**Performance Indicator:** Identify a wave's behavior as reflection, refraction, diffraction, or interference, given an example.

**38** A light ray is entering a container of water.



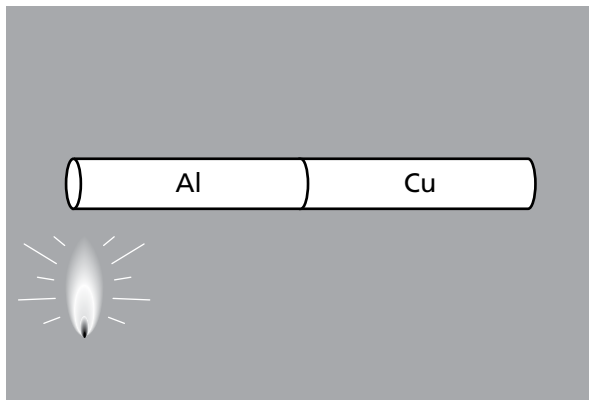
As a light ray enters water, it bends due to

- F** reflection
- G** diffraction
- H** refraction
- J** interference

EP010167

**Performance Indicator:** Classify the transfer of heat energy as conduction, convection, or radiation, given an example.

**39** Two metal pipes are placed together as shown below.



How does heat most likely spread from the aluminum (Al) pipe to the copper (Cu) pipe?

- A** convection
- B** conduction
- C** radiation
- D** refraction

EP010210

**Performance Indicator:** Select a scenario that represents the law of conservation of energy, given an illustration.

**40** Which energy conversion correctly shows the law of conservation of energy?

**F**

|                               |                                |   |                           |
|-------------------------------|--------------------------------|---|---------------------------|
| chemical<br>energy<br>44,000J | → kinetic<br>energy<br>12,000J | + | heat<br>energy<br>32,000J |
|-------------------------------|--------------------------------|---|---------------------------|

**G**

|                                 |                                   |   |                            |
|---------------------------------|-----------------------------------|---|----------------------------|
| potential<br>energy<br>100,000J | → electrical<br>energy<br>40,000J | + | heat<br>energy<br>500,000J |
|---------------------------------|-----------------------------------|---|----------------------------|

**H**

|                              |                              |   |                            |
|------------------------------|------------------------------|---|----------------------------|
| nuclear<br>energy<br>90,000J | → light<br>energy<br>27,000J | + | heat<br>energy<br>113,000J |
|------------------------------|------------------------------|---|----------------------------|

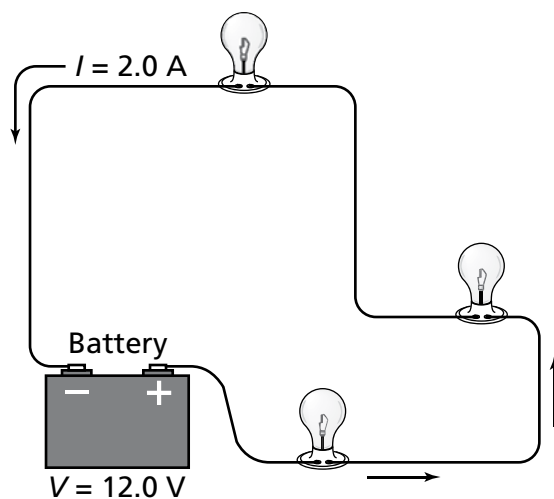
**J**

|                                  |                                   |   |                           |
|----------------------------------|-----------------------------------|---|---------------------------|
| biochemical<br>energy<br>38,000J | → mechanical<br>energy<br>38,000J | + | heat<br>energy<br>38,000J |
|----------------------------------|-----------------------------------|---|---------------------------|

EP010377

**Performance Indicator:** Solve application problems related to voltage, resistance, and current in a series circuit, given the equation.

- 41** A series circuit has a total resistance,  $R_T = R_1 + R_2 + R_3$ . The voltage from the battery and the current for the circuit are shown below.



Given Ohm's law,  $V = IR$ , what is the total resistance of the circuit?

- A** 0.0830 ohm
- B** 6.00 ohms
- C** 10.0 ohms
- D** 24.0 ohms

EP010376

**Performance Indicator:** Distinguish between nuclear fission and nuclear fusion, given a scenario.

- 42** Heavy nuclei are bombarded with neutrons to produce smaller nuclei and energy. This process is called

- F** nuclear fusion
- G** nuclear fission
- H** ionizing radiation
- J** radioactive decay

EP010083

**Performance Indicator:** Solve problems regarding heat, mass, specific heat capacity, and temperature change, given the equation.

- 43** The table below shows the data collected during an investigation on heat.

| Metal  | Mass   | Specific Heat (J/kg·K) | T <sub>i</sub> (K) | T <sub>f</sub> (K) |
|--------|--------|------------------------|--------------------|--------------------|
| copper | 2.0 kg | 390                    | 253                | 273                |

Using  $Q = mc\Delta T$ , approximately how much heat was gained by the sample of copper?

- A** 780 J
- B** 3900 J
- C** 7800 J
- D** 16,000 J

EP010174

## Answer Key

| <b>Reporting Category 1: Force and Motion</b> |                       |   |
|---|-----------------------|---|
| <b>Item Number</b>                            | <b>Correct Answer</b> | <b>Performance Indicator</b>  |
| <b>1</b>                                      | <b>C</b>              | 1.1.1 Distinguish between speed and velocity, given a scenario.   |
| <b>2</b>                                      | <b>G</b>              | 1.2.1 Relate inertia, force, or action-reaction forces to Newton's three laws of motion, given an illustration, diagram, or scenario.                   |
| <b>3</b>                                      | <b>B</b>              | 1.3.1 Distinguish between mass and weight using SI units, given examples.   |
| <b>4</b>                                      | <b>F</b>              | 1.4.1 Identify simple machines, given illustrations of machines in action.  |
| <b>5</b>                                      | <b>B</b>              | 1.5.2 Interpret a distance-time graph for velocity or a velocity-time graph for acceleration, given the appropriate graph.                              |
| <b>6</b>                                      | <b>G</b>              | 1.6.2 Solve application problems related to velocity, acceleration, force, work, and power using appropriate units of measurement, given the equations. |
| <b>7</b>                                      | <b>A</b>              | 1.7.2 Distinguish among the concepts inherent in Newton's three laws of motion, given a scenario.   |
| <b>8</b>                                      | <b>H</b>              | 1.8.2 Choose the illustration or scenario that relates the effect of gravitational force on falling bodies or satellites.                               |
| <b>9</b>                                      | <b>B</b>              | 1.9.2 Recognize the simple machines found in a compound machine, given an illustration of a machine in action.  |
| <b>10</b>                                     | <b>H</b>              | 1.10.2 Solve application problems related to mechanical advantage and the efficiency of simple machines, given appropriate equations.                   |
| <b>11</b>                                     | <b>B</b>              | 1.11.3 Choose the correct representation of the law of conservation of momentum, given an illustration.   |



## Answer Key

| <b>Reporting Category 2: Structure and Properties of Matter</b> |                       |   |
|---|-----------------------|---|
| <b>Item Number</b>  | <b>Correct Answer</b> | <b>Performance Indicator</b>  |
| <b>12</b>   | <b>J</b>              | 2.1.1 Distinguish among the phases of matter in terms of volume, shape, and particle arrangement, given illustrations.  |
| <b>13</b>   | <b>C</b>              | 2.2.1 Identify a material as a pure substance or a mixture, given a description of the material.  |
| <b>14</b>   | <b>J</b>              | 2.3.1 Distinguish among elements, compounds, solutions, colloids, and suspensions, given examples.  |
| <b>15</b>   | <b>D</b>              | 2.4.2 Identify common elements, given symbols or names.   |
| <b>16</b>   | <b>J</b>              | 2.5.2 Distinguish between metals and nonmetals, given examples.   |
| <b>17</b>   | <b>B</b>              | 2.6.2 Identify the three major subatomic particles (protons, neutrons, and electrons) based on their location, charge, and relative mass, given descriptions.   |
| <b>18</b>   | <b>H</b>              | 2.7.2 Identify chemical formulas for common compounds (i.e., $\text{H}_2\text{O}$ , $\text{NaCl}$ , $\text{CO}_2$ , $\text{HCl}$ , $\text{Fe}_2\text{O}_3$ , $\text{C}_6\text{H}_{12}\text{O}_6$ , $\text{NaOH}$ ). |
| <b>19</b>   | <b>D</b>              | 2.8.2 Solve application problems related to density, mass, and volume, given the equation.  |
| <b>20</b>   | <b>G</b>              | 2.9.2 Predict the behavior of an object in a fluid, given relative densities.   |
| <b>21</b>   | <b>B</b>              | 2.10.2 Identify the atomic number, atomic mass, number of protons, number of neutrons, and number of electrons in an atom of a given element, using the periodic table.   |
| <b>22</b>   | <b>G</b>              | 2.11.2 Analyze the relationships among pressure, temperature, volume and speed of gases, given a scenario.  |

## Answer Key

| <b>Reporting Category 3: Interactions of Matter</b> |                       |   |
|---|-----------------------|---|
| <b>Item Number</b>                                  | <b>Correct Answer</b> | <b>Performance Indicator</b>  |
| <b>23</b>   | <b>A</b>              | 3.1.1 Determine whether a change in matter is physical or chemical, given a scenario.   |
| <b>24</b>   | <b>G</b>              | 3.2.1 Identify the reactants and/or products in a chemical reaction, given a chemical equation.                               |
| <b>25</b>   | <b>C</b>              | 3.3.1 Identify a substance as acidic, basic, or neutral, given its pH.  |
| <b>26</b>   | <b>J</b>              | 3.3.1 Identify a substance as acidic, basic, or neutral, given its pH.  |
| <b>27</b>   | <b>C</b>              | 3.4.2 Identify a chemical bond as ionic or covalent, given the elements in a compound.  |
| <b>28</b>   | <b>G</b>              | 3.5.2 Identify a chemical reaction as synthesis, decomposition, single-replacement, or double-replacement, given an equation. |
| <b>29</b>   | <b>B</b>              | 3.6.2 Select the correct coefficient(s) to balance a chemical equation, given a list of coefficients.                         |
| <b>30</b>   | <b>G</b>              | 3.7.2 Apply the law of conservation of mass in a chemical reaction by selecting the balanced equation.                        |
| <b>31</b>   | <b>A</b>              | 3.8.2 Distinguish between endothermic and exothermic reactions, given a description of the temperature change in a reaction.  |
| <b>32</b>   | <b>F</b>              | 3.9.2 Identify the effect of acid rain on the environment, given a scenario.  |
| <b>33</b>   | <b>C</b>              | 3.10.3 Select the product(s) given the reactant(s) of a chemical reaction.  |

## Answer Key

| <b>Reporting Category 4: Energy</b> |                       |  |
|-------------------------------------|-----------------------|--|
| <b>Item Number</b>                  | <b>Correct Answer</b> | <b>Performance Indicator</b>   |
| <b>34</b>                           | <b>F</b>              | 4.1.1 Classify a wave as transverse or longitudinal, given a description or an illustration.   |
| <b>35</b>                           | <b>B</b>              | 4.2.1 Identify wavelength, frequency and amplitude, given a description or an illustration.  |
| <b>36</b>                           | <b>G</b>              | 4.3.1 Identify the boiling and/or freezing point of water, given the Celsius, Fahrenheit, or Kelvin temperature scales.                        |
| <b>37</b>                           | <b>B</b>              | 4.4.2 Classify sound as a longitudinal, mechanical wave and light as a transverse, electromagnetic wave, given an illustration or description. |
| <b>38</b>                           | <b>H</b>              | 4.5.2 Identify a wave's behavior as reflection, refraction, diffraction, or interference, given an example.                                    |
| <b>39</b>                           | <b>B</b>              | 4.6.2 Classify the transfer of heat energy as conduction, convection, or radiation, given an example.  |
| <b>40</b>                           | <b>F</b>              | 4.7.2 Select a scenario that represents the law of conservation of energy, given an illustration.  |
| <b>41</b>                           | <b>B</b>              | 4.8.2 Solve application problems related to voltage, resistance, and current in a series circuit, given the equation.                          |
| <b>42</b>                           | <b>G</b>              | 4.9.2 Distinguish between nuclear fission and nuclear fusion, given a scenario.  |
| <b>43</b>                           | <b>D</b>              | 4.10.3 Solve problems regarding heat, mass, specific heat capacity, and temperature change, given the equation.                                |

